



Contribution ID: 121

Type: **not specified**

## Integration of mini TECs on the CMS MTD barrel timing layer 16 ch SiPM array to reduce the DCR after very high irradiation

*Thursday, March 18, 2021 1:00 PM (20 minutes)*

The need to operate SiPM after very high radiation levels in current and future HEP detectors is growing. The proposed CMS MTD Barrel timing layer (BTL) will see a total neutron flux of  $2E14$  n/cm<sup>2</sup> (1 MeV eq.) at the end of operation (EOO). This new sub-detector is located just outside of the CMS Tracker and is already planned to be operating at a cryogenic temperature of -35°C. In the last two years R&D was conducted to investigate the potential integration of mini thermal electric coolers (TECs) directly on the BTL 16 channel SiPM package. It is shown that the SiPM operating temperature can be further decreased from -35 to -45°C and the SiPM current reduced by a factor of 1.9 with little additional overall power consumption if the TEC coefficient of performance (COP) is optimized. We also show that by reversing the current in the TECs, the local increase in the SiPM temperature can be exploited to enhance the annealing of the SiPM's Dark Count Rate (DCR) during yearly LHC shutdowns.

We review the current knowledge on the evolution of the SiPMs under irradiation up to the full EOO integrated fluence and what level of dark current mitigation could be achieved by integrating the TECs into the BTL design.

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**Session Classification:** Photodetectors

**Track Classification:** Photodetectors